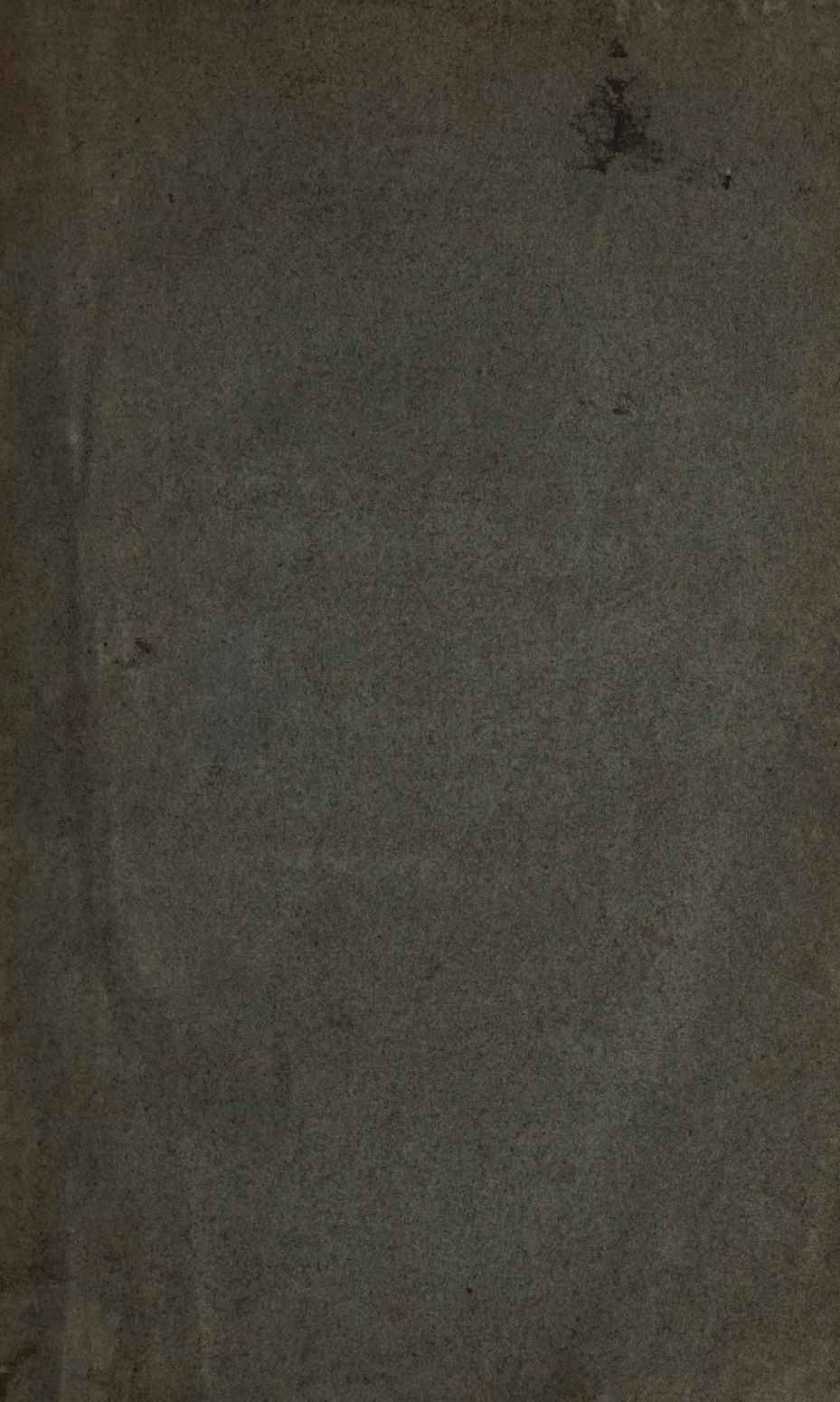
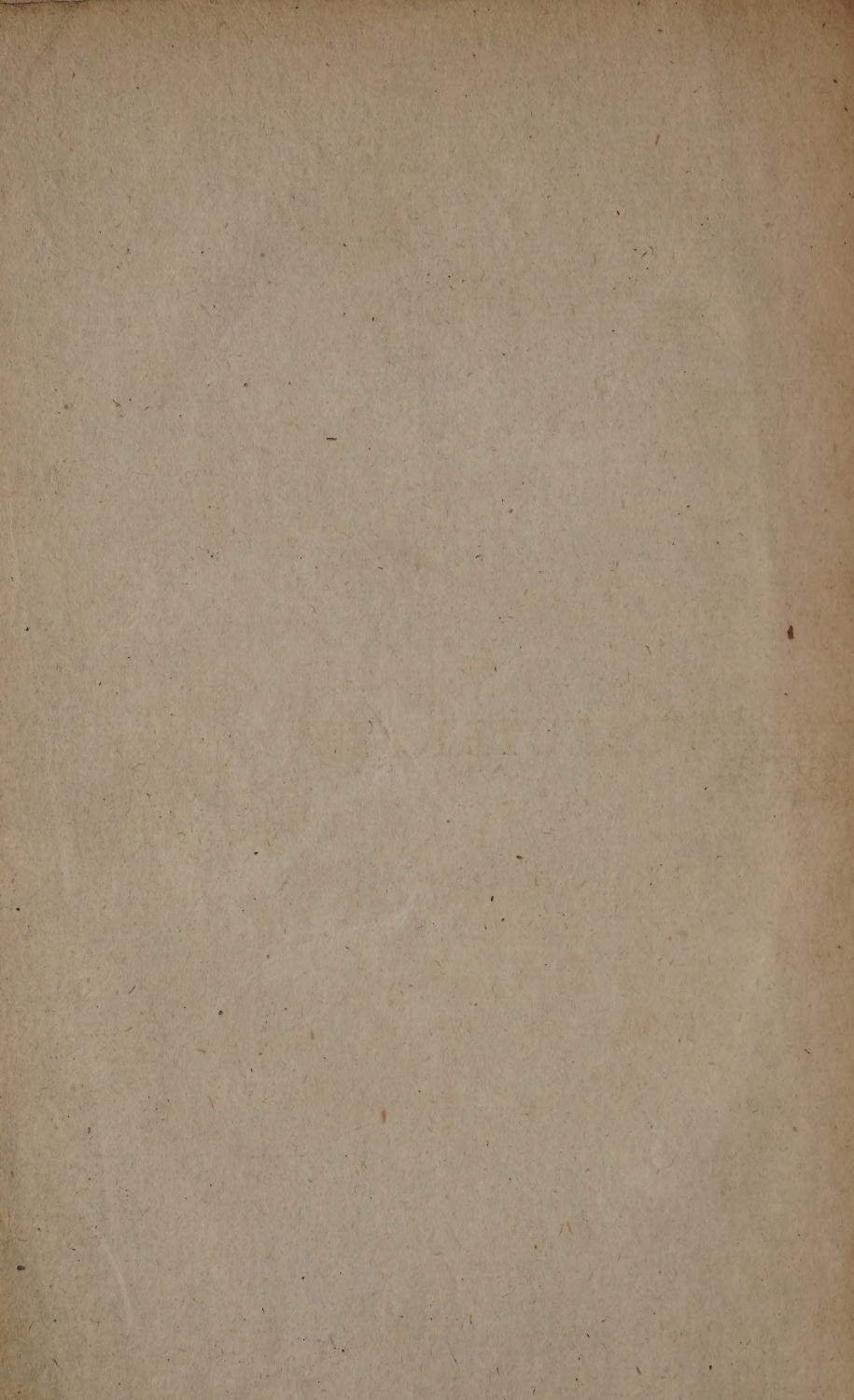




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Stephens, 1818.

ON
ELECTRICITY.

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ELECTRICITY;
WITH
OCCASIONAL OBSERVATIONS
ON
MAGNETISM.

POINTING OUT THE INCONSISTENCY AND FALLACY
OF THE DOCTRINE OF
POSITIVE AND NEGATIVE ELECTRICITY:
AND
INVESTIGATING AND EXPLAINING
THE TRUE
PRINCIPLES, COMPOSITION, AND PROPERTIES
OF
ELECTRIC ATMOSPHERES.

By E. PEART, M.D.

And corresponding Member of the Medical Society of London.

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On ELECTRICITY.

A BODY is in an *electric state*, when it is capable of attracting, and then repelling light bodies, within a certain distance of it; and, as that state is communicable, or destructible, at pleasure, 'tis evident, that it must depend upon some kind of *subtile fluid*, surrounding the surface of the body electrified like an *atmosphere*; and all the phenomena of electricity are produced by the active properties of this electric atmosphere.

2. The only general active property of this electric fluid is *attraction*; for when any body ac-

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quires an electric atmosphere, it invariably attracts all bodies, in their natural or common state, if within its extent; and light substances are drawn to its surface.

3. It hath, seemingly, another property, that of repelling the light substances it had attracted; and, indeed, all other bodies, possessed of an atmosphere similar to its own: for, the light bodies attracted by it, are never repelled, till they acquire an electric atmosphere themselves, similar to that of the body to which they were attracted, and then they recede from it; not by any repulsive power, but, merely by their levity; for, as the particles forming the atmosphere of the larger body, naturally arrange themselves in a certain manner, with a certain degree of force; the presence of the smaller body, with its atmosphere, disturbing that arrangement, will naturally be pushed away by the force of attraction which those particles exert, to recover their proper arrangement: by which means, the lighter body with its atmosphere, will be pushed to the surface
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of the larger atmosphere, 'till they only touch each other, at their surfaces.

4. If, then, this power of attracting light bodies in their common state, be constantly attendant on every body which we know has an electric atmosphere, we have *no* right to say, that any simple body is possessed of electricity, unless it shews some signs of this attraction, when a light body is presented to it,

5. If a tube of glass is brought near to a feather, suspended by silk, it does not attract it ; if a piece of silk is brought to the feather, it does not attract it ; therefore, neither the glass nor the silk have an electric atmosphere ; but, if the glass be rubbed with the silk, it will then attract the feather, which proves that it then hath acquired an electric atmosphere. All that can be inferred from hence, is, that there is a subtle fluid, which, in its natural state, possesses no properties by which it is evident to us ; but that, by the action of the rubber upon the glass, it becomes excited

to form an atmosphere, around the glass, capable of attracting light bodies to its surface: this fluid, therefore, is constantly and universally present, but is never electric, but in consequence of a proper excitement.

6. If a globe of glass, connected with a conductor, insulated, be excited by means of a proper rubber, insulated and connected to a similar conductor insulated also, the glass and its conductor, will acquire an electric atmosphere, and attract a feather;—and at the same time, the rubber, and the conductor connected with it, will attract a feather, and, consequently, have an electric atmosphere also.

7. If a feather, suspended by silk, be brought near the glass, or its conductor, it will be attracted; and acquiring a similar atmosphere, will recede, till it floats upon the surface of the electric atmosphere surrounding the glass and its conductor, and will not again approach it.

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If, in like manner, another feather be brought near the rubber, or its conductor, it will be attracted and then repelled, without being capable of again coming near to it.

8. But, if the feathers be changed, that which was repelled by the glass, will be rapidly drawn to the rubber; and that, which was pushed away from the rubber, will be as eagerly attracted by the glass.

9. These experiments fully prove, that the glass and the rubber, with their respective conductors, have each an electric atmosphere; because each is capable of attracting a feather; of communicating an electric atmosphere to it, and then of pushing it away to its surface: and it as clearly proves, that the electric atmosphere of the glass, is *different* from that of the rubber; for, though they are both in a similar state of excitement, yet, what is repelled by the one, is attracted by the other.

10. The commonly adopted explanation of these experiments, is, that every body, naturally, contains a quantity of electric fluid, which is not evident, but when its equal diffusion is destroyed; that the glass, and the rubber, by friction, destroy this equilibrium, in consequence of which, the glass, and the conductor connected with it, acquire *more* than their natural share of it, while the rubber, and the bodies connected with it, are *deprived* of theirs; consequently, that the glass is in a *positive*, and the rubber in a *negative* state of electricity: but, in the first place, I object that there is no proof of simple bodies containing any electricity, but when they are capable of attracting other light bodies (4); 2,^{ly} that it is not natural, or reasonable, to suppose that by rubbing two bodies together, each possessed of an equal quantity of electricity, one should attract the electric fluid naturally belonging to the other: there is no reason to be given why it should be so, and there is no necessity to suppose that it is so. 3,^{ly} If silk will impart its electric fluid, by being rubbed upon glass, what is the reason why it will not impart

impart it to every other body, by being rubbed against it, if all are, naturally, in an equal state of electricity? 4.th When a feather is brought near to glass, positively electrified, it is said that the electric atmosphere of the glass, attracts the feather, because that feather contains less electricity than the glass; but, how is it then attracted to the rubber which contains no electricity?—'tis said that the natural electricity of the feather attracts the rubber, which contains less, or none; and, that attraction carries it to the rubber; then, in a general way, the feather will attract the rubber at the distance of six inches, for instance, though it may be made to attract it further, consequently, the feather must have a natural electric atmosphere, of twelve inches diameter, to enable it to attract the rubber, in its negative state; if so, every feather, naturally, hath a positive atmosphere of electric fluid, of at least twelve inches diameter; and therefore, no two feathers ought, naturally, to approach each other nearer than twelve inches; because each, being naturally positively electric to that extent, they ought to
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repel each other : but they do not repel each other, naturally ; therefore, they have no natural electricity ; and the doctrine of negative electricity hath no foundation in nature.

Again,—When a body, negatively electrified, attracts a feather, or is attracted by a feather in its natural state, it is said that the feather communicates part of its natural electricity to the negative body, and is then repelled by it in a negative state ; if another feather be applied to it, it will be repelled also, in a negative state ; yet, these two feathers, although each hath been robbed of a great part of its natural electricity, will not approach each other, but repel one another to a considerable distance ; and that, as forcibly, as though they were positively electrified ; and that they have, each, an electric atmosphere, I firmly maintain ; otherwise, they could not repel each other : for, if they have less electric fluid surrounding them, after being attracted and then repelled, by a body negatively electrified, than when in their natural state, as must be the case if
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the doctrine of positive and negative electricity be true, then, in their natural state, they ought to repel each other, much more, than when they are in a negative state.

Every one must allow, that a body negatively electrified, appears to be as truly, and really furrounded by an electric atmosphere, as a body positively electrified : a body negatively electrified produces all the appearances of electricity, as well as the positive one ; and so perfectly do they resemble each other, that we, in general, cannot know whether the body electrified is possessed of more than its natural share, or hath no electric atmosphere at all about it, only by examining whether, or not, the body in question will attract, or repel a body, whose electric state is known. Why, then, must we admit of a theory, which plainly gives the lie to all our senses, in every electrical experiment ; when plain sense, with a little attention, will point out the falsity of the doctrine of positive and negative

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electricity,

electricity, by clearly shewing the principles, by which the electrical appearances are produced?

12. Let us, then, divested of all theory, simply attend to what in reality happens. Suspend a feather by a thread of silk; bring it near to a tube of glass; it is not attracted nor repelled; we have, therefore, no right to say that the glass hath any electric atmosphere; because, if it had, the feather would either be attracted or repelled; but, it is neither; therefore, the glass hath no electric atmosphere. Let the glass be rubbed with a piece of silk, or any thing proper for the purpose; it will then attract the feather, which shews, that there was, naturally, some active principle adhering to the glass, which, by friction, is excited to form itself into an electric atmosphere, around it; which electric atmosphere, hath the power of drawing the feather, if within its extent, to the surface of the glass.

If

If the rubber be tried, in its natural state, it hath no attraction to the feather, and, consequently, no electric atmosphere; but, if it be insulated, by then exciting the glass, it, too, will be found to have an electric atmosphere, capable of attracting a feather; consequently, it is naturally accompanied with some active principle, also; which, by means of friction with glass, is excited to become an electric atmosphere upon its surface.

When the feather hath been attracted, by the electric atmosphere of the glass, it is then repelled (3),—and will approach it no more; the reason of which is found to be, the feather hath acquired an electric atmosphere, similar to that surrounding the glass, and is pushed aside by that atmosphere. But, if that electrified feather, be brought near to the excited rubber, it is attracted by it; which shews that the electric fluid of the rubber, is a *different* kind of fluid from that of the glass; and that when the two are both excited to become electric, they have a strong attraction to each

other ; for, if the feather be electrified, by the rubber, and repelled by it, it will again be attracted by the electric atmosphere of the glass.

13. There are therefore two active principles, naturally surrounding all bodies ; in which state they are imperceptible to us : Some bodies naturally attract one, or both of these principles, more tenaciously than others ; and when these bodies particularly, are excited by friction, the active fluids adhering to their surfaces, receive a certain degree of excitement, which causes their particles to arrange themselves, in a certain manner, so as to form atmospheres around those bodies, rubbed together ; and these excited atmospheres, have the power of attracting other bodies, with a certain force, on account of the presence of those principles, in their natural state, accompanying all bodies. Two bodies, possessing atmospheres of the same active principle, have no attraction ; but press upon, and seem to repel each other ; but, an atmosphere of one kind, surrounding a body, will strongly attract an atmosphere of the other kind

kind, surrounding another body, and, by uniting together, will destroy each other's electric properties, and escape with a noise and light, if the two bodies are brought sufficiently near to each other.

14. There is another circumstance, to be particularly attended to, which is, that neither of these fluids can assume an electric state, unless the other, becomes electric also.

They are naturally combined, and every where present; and if one be excited, the other, by that means, becomes excited also; for, whenever they separate from their general, or natural state of combination, each immediately becomes active: therefore, whenever one of them becomes electric around the glass, the other, at the same time, assumes the same state upon the rubber. And the same law takes place in magnetism; the phenomena of which, depend upon the same two active principles, only in a different state of excitement. Iron, naturally, hath a peculiar attraction to each;
and

and a needle, in its common state, is surrounded by them both, in their natural state of combination. If, by any means, one of the active fluids becomes excited, it assumes an atmospheric state around one end of the needle, and the other, at the same time, arranges itself round the other extremity of the needle, which is then magnetic: that is, either pole, or end of the needle, by means of the atmosphere around it, will attract iron; which fully proves that each pole, is possessed of an atmosphere, having that attractive property. But, two similar poles, or two poles, possessed of the same kind of fluid, like two bodies surrounded by the same kind of electric atmosphere, will not attract, but resist or repel each other; whilst the two opposite poles of two needles, one being surrounded by one active fluid, and the other by the other, will forcibly rush together; in the same manner, as a feather, electrified by the glass, will strongly attract another, having its electric atmosphere from the rubber; which fully proves that the active fluid rendering one end of a needle magnetic, is *different*, from
that

that surrounding the other; and is strongly attractive to it.

Again, if the extremity of a needle, in a magnetic state, that is, possessed by one of the active fluids, be applied to the extremity of another, having both the fluids around it in their common state of combination, that fluid, in a magnetic state, will attract the other kind of fluid, naturally surrounding the unexcited needle, to that end which it touches; by which means, that *other kind* of fluid becomes excited, and acquires magnetic properties, at that end of the needle; and, at the same time, the other fluid, separated from it, rushes to the other, or further end of the needle, and surrounds it in the state of an atmosphere, magnetic also: and this needle, when separated from the magnet, will remain magnetic; having *all* its active fluid of *one* kind, at *one* of its extremities; and all the *other* kind of fluid at the *other*: which proves to a demonstration, that when one fluid is excited to become a magnetic atmosphere, the other becomes a magnetic atmosphere also; in
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the same manner, as when one is excited to become an electric atmosphere, by surrounding the glass, the other, at the same time, arranges its particles in a similar manner, around the rubber, and is possessed of similar electric properties; and, in both cases, the excited fluid, of either kind, strongly attracts the other, in a similar state of excitement with itself.

15. These two active principles, for the sake of convenience and distinction, I have formerly called *Æther* and *Phlogiston*; and shall, therefore, continue, in the following pages, occasionally, to call them by those names: and shall esteem them, as principles, whose existence is incontestible, and fully demonstrated. These, likewise, I call *contrary active principles*, because, each hath its specific properties; and in similar states of excitement, they attract, and counteract each other; so, that each destroys the evident properties of the other.

16. There

16. There are, therefore, two active principles, *Æther* and *Phlogiston*, naturally combined together, and every where present: in certain circumstances, they are capable of being excited to attract the surfaces of different substances, acting upon each other; by which excitement the particles of each kind, arrange themselves, in a certain manner, so as to form, by their contiguity, lines of particles, attracting each other with a certain force; and the lines of particles of one kind, excited to attract the surface of the glass, strongly attract the lines of particles of the other kind, attracting the rubber. These fluids, thus excited to this arrangement and attraction, strongly confine the glass to the rubber; but, if the excited surfaces be separated, by force, each will so strongly attract its respective fluid, that those fluids will separate from each other, rather than from the surface, to which each, by this excitement, is so strongly attracted; and, by this separation, the two fluids, being no longer capable of attracting each other, will, each, retain the linear arrangement of its particles: and one will form

an atmosphere upon the surface of the glass, and the other upon the rubber; in which state, each will become attractive to every body in its natural state, within its extent; because, every body, in its natural state, is accompanied by both principles; and consequently is attended by the opposite principle, to that which is excited either upon the surface of the glass, or the rubber, and for which it hath an attraction; and, whenever the two excited fluids meet again, they again attract each other.

17. Having thus proved that *Æther* and *Phlogiston*, by means of friction, are capable of being excited, to form themselves into atmospheres, one upon the surface of the glass, and the other upon the rubber; and in that state, produce the appearances which we call *Electric*; we must pursue the subject, still further, and examine those electrical appearances themselves; and the first phenomenon, which excited the attention of philosophers, and hath never been yet explained, in a rational and satisfactory manner, is, that
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when a light body, hath been attracted by an electric atmosphere, it is immediately repelled, if suspended by a non-conductor of electricity.

18. To attempt to account for it by the doctrine of positive and negative electricity, would be as ridiculous as ineffectual; for instance, let a conductor containing 100 square inches of surface, be *negatively* electrified, that is, deprive it of its natural electricity:—Let a small pith ball, of one tenth of an inch diameter, suspended by a filament of silk, be brought towards it:—at a considerable distance, say twelve inches, an evident attraction takes place;—what causes that attraction?—the electric fluid.—What does that electric atmosphere, or fluid belong to?—not to the large conductor, because it is said to have *no* electricity about it; therefore, it is the natural electric atmosphere of the little ball, which, at the distance of twelve inches, begins to shew its attraction upon the conductor:—another, similar ball, would do the same, and, according to this doctrine, must also have a positive natural electric

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atmosphere, of twenty-four inches extent ; consequently, as two bodies, in a similar state of electricity, repel each other, these two balls, naturally, ought to repel each other to the distance of twenty-four inches :—but they do not refuse to come into immediate contact—consequently, naturally, they have no electric atmospheres around them, as before observed (10).

But, for a moment, admit that this little ball does attract the prime conductor, by its natural electric atmosphere, at the distance of twelve inches ; if it be permitted it will approach the conductor, and then will be as evidently repelled, by any part of that conductor, to the distance of twelve inches ; consequently, if the doctrine of positive and negative electricity be true, that little ball, must have communicated so much positive electricity, to the whole 100 inches of surface, of the conductor, as will surround it to the distance of six inches ; because every point of it, will now repel the ball, to the distance of twelve inches ; and, consequently, every part of it, is in the same
state

state with the ball itself, which it now repels: therefore, the ball must have an atmosphere of six inches, and every point of the conductor an atmosphere of equal extent: But, it is impossible that the little ball, could communicate so much electricity, to a conductor of that extent of surface; and, therefore, it is impossible, that the doctrine of positive and negative electricity should be true, or capable of explaining the experiment in question.

If it be objected, by way of getting over this difficulty, that the ball does not communicate, so much of its electric fluid, as to give the conductor an atmosphere of equal extent, with its own remaining atmosphere, then, I answer, any particular part of the conductor, to which the ball may be opposed, does not contain so much electricity as itself; and, the ball should be again attracted; but, were the plus and minus doctrine true, after the ball and conductor have been in contact, each must have an equal extent of atmosphere; for it, being the nature of the electric fluid, to diffuse
itself

itself equally, the ball, as being as it were a part of the surface of the conductor, while in contact with it, could retain no more than its equal share of the electric fluid, and, therefore, in reality, when repelled, its atmosphere ought to be much less than six inches in extent, and the electric fluid equally divided between the ball and conductor, should then, repel it to a very inconsiderable distance indeed; which, not being the case, shews, at once, the futility of the objection, and the doctrine upon which it is founded. Setting this plus and minus doctrine, therefore, aside, I shall consider the experiment, minutely, as it proceeds; after again reminding my reader, that what are called positive and negative electricity, are no other than *Æther* and *Phlogiston*, or two different active fluids, when they are excited by any means, separately, to arrange themselves in an atmospheric state, around bodies; in which state, each hath a general attraction to matter, which we call electric, and a particular attraction to the other.

19. If, therefore, a body be insulated, and electrified, it will attract a small pith ball, suspended by silk. Suppose the body to be the large conductor of an electrical machine, and to attract the ball of one tenth of an inch diameter, at the distance of six inches. If the ball be freely suspended, it will be attracted to the conductor, and then repelled.

20. Suppose the ball be only suffered to approach within three inches of the conductor, and be then withdrawn, it will be found *unaltered* with respect to its natural state; that is, it hath acquired *no* electric atmosphere; which fully proves, that, by being *completely surrounded* by the electric atmosphere, it does *not*, in this case, acquire any of it to itself.

21. But, if the ball be gradually suffered to approach the conductor, a little before it comes in contact with it it will be repelled, and recede from it, at least as far as before it was attracted, and is then found to be surrounded by
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an electric atmosphere, similar to that of the conductor.

22. It appears, then, that the conductor hath an atmosphere which attracts the ball, for several inches, 'till it approaches to a *certain small distance* from its surface; and, that then, without coming in contact with the conductor, the ball is repelled, through the full extent of the atmosphere, which, before, attracted it; consequently, the ball, now that it is repelled, must be in a *different* state, from what it was *before*, when it was attracted:—wherein does its state differ?—it now hath a similar atmosphere of its own.

23. Then, it appears, that the external part of the atmosphere of the conductor, uniformly attracted the ball, and, if withdrawn, after being totally immersed in that atmosphere, it still was attracted by it, and was still without any electric atmosphere of its own (20): But, so soon as it approached, within a certain distance from the surface of the conductor, it acquired an electric
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atmosphere itself, and becoming in a similar state with the conductor, was no longer attracted, but pushed away by the larger atmosphere of the conductor, to its surface.

24. It must, therefore follow, that the atmosphere, immediately surrounding the surface of the conductor, is of a *different* nature from that more distant; because, the latter is not capable of communicating electric properties to the ball, when immersed in it, but the former is; and, as the ball, after it hath thus been attracted and repelled, is in an electric state, and capable of attracting and repelling other light bodies, it shews, that it too, is then in the same state with the conductor itself; that is, that it hath an atmosphere *immediately* surrounding its *surface*, *different* from its *external* atmosphere: that the *external* attracting atmosphere, draws light bodies towards it, 'till they reach the *internal*, and *different* atmosphere: that they then become electric, and are pushed away; and, consequently, that an electrified body communicates electricity

to another, by giving it *part* of its *internal* atmosphere, by the acquisition of which, that other body attracts its proportionate share of the *external* atmosphere of the former, and, being thus rendered completely electric, is pushed away, by the larger atmosphere of the greater body (3).

25. It appears probable, nay evident, then, that a body in an electric state, hath an atmosphere, or atmospheres of different kinds, or of different properties; and that the existence of one, depends upon that of the other; and the properties which we call electric, upon both: for, the ball cannot become electric, till it is brought in contact with the *internal* atmosphere of the conductor, when, it is immediately surrounded by it, and then attracts part of the *external* atmosphere of the conductor also; which it could not do till it was surrounded by this internal atmosphere (20), and then, that it does attract part of the external atmosphere is evident, from its possessing it, and being completely electric.

26. This

26. This double electric atmosphere, in some experiments, is too evident to admit of a doubt about its veracity; and the only means of explaining them, I shall at present instance one—If a large conductor, or ball of metal, be highly electrified, it will attract a small pith ball, and then repel it in an electric state; but, if that ball be forcibly introduced to the surface of the electrified conductor, or ball of metal, by means of a non-conductor, or be accidentally attracted and immersed in its internal atmosphere, it will remain strongly attracted to its surface, and may be moved around it in any direction.—The ball of pith being small, is totally immersed in, and covered by the internal atmosphere of the conductor, or metal ball, and, by it, is firmly attracted to its surface; but, if it be raised out of that internal atmosphere by which it was attracted, and which adheres to its surface, so, as to reach the external atmosphere, it immediately attracts part of that atmosphere, around itself, and becoming electric, is repelled, or driven to the surface of the external atmosphere, surrounding

the conductor, or ball of metal. Which, not only proves that every electric body, hath an internal and external atmosphere, of different kinds, or properties, but, that, each of those atmospheres, are attractive to matter, and both essential to the electric state; and also, that the extent of the internal atmosphere is very small, in proportion to the external one.

27. A body, therefore, when in an electric state, hath an *internal* atmosphere immediately surrounding its surface, to a small extent; and beyond that, an *external* atmosphere, of a different kind, of a very considerable extent.—If a small, light, floating body comes within the external atmosphere, it is drawn towards the electrified body, till it reaches the internal atmosphere, by which it is attracted, and surrounded, and, is then enabled to attract a proportionate share of the external atmosphere, which brought it; by which means, it becomes possessed of an atmosphere of each kind, of its own, and, being in a similar state with the larger body, it is no longer attracted,

attracted, but pushed away, by the atmosphere of the larger body, till it floats upon its surface (3).

28. If my reader will accompany me, we will now attend to the two general kinds of electricity, that obtained from the glass, and the other kind, at the same time produced on the rubber, (12 and 13), which were shewn to be of different kinds, similar, indeed, in their appearances, but being different active principles, in the same state of excitement; having, at the same time, an eye to the double atmosphere, necessary, to produce electrical appearances; that they may either confirm, or confute each other, accordingly as they are true, or false.

29. It hath been generally known that when two bodies, have each an electric atmosphere of the same kind, they resist, or repel each other; and, that two bodies, in the contrary states of electricity attract each other. It hath been sufficiently proved that each state, depends upon an active fluid, in an atmospheric state, surrounding the

the body electrified by it, and, consequently, whenever two electric atmospheres attract each other, we are certain, that they are formed the *one* of one of the kinds of active matter called *Phlogiston*, and the *other* by the other kind, distinguished by the name of *Æther*.

30. Let, then, an insulated body be electrified from the glass of an electrical machine, and another similar body from the insulated rubber. A feather, then, electrified, and repelled by one, will be attracted by the other.

31. Let us, for a moment, examine the explanation offered by the doctrine of positive and negative, or plus and minus electricity, and see whether it can take place in this experiment, or not.

The body electrified by the glass is said to be plus, or to have more than its natural share of the electric fluid; and that, connected with the rubber, is minus, or is said to have less than its natural share, or none at all,

Bring

Bring a feather, or other light body, in its natural state, suspended by a non-conductor, towards the body *positively* electrified, and observe at *what distance*, it evidently begins to attract it—Let that feather, again reduced to its natural state, be attracted to the body *negatively* electrified; it will afterwards be repelled—Why?—because, 'tis answered, it hath parted with a considerable part of its natural electricity to the body in its minus state, and, consequently, now that it is repelled, it is *minus also*; having *much less* electricity about it, now, than it had in its natural state; consequently, the extent of its electric atmosphere, ought to be *less*, and if brought again towards the body positively electrified, it should not be attracted at *so great a distance*, as in the former case, when its electric atmosphere was more extensive: but, experiment proves, that it is *now* attracted, at a *greater distance* than before, and with *more violence* too; which fully proves that instead of having *lost* part of its electric atmosphere, by being attracted, and then repelled by the body said to be negatively electrified

trified, in reality, it hath *acquired a more extensive* electric atmosphere, by which, it *sooner* comes in contact with the atmosphere of the body electrified from the glass; and, that the atmosphere acquired is also *more strongly* attracted by the electricity of the glass, than the electric principle is, when in its natural state: consequently, the doctrine of plus and minus electricity, in every view, is *false*, and without any foundation in nature.

32. Let us now again abandon the theory of negative electricity, and attend carefully to the subject; making use of reason, alone, to investigate the cause of the appearances which present themselves.

The body electrified from the glass, then, is surrounded by an atmosphere of active particles of matter, of a *certain* kind; and the body rendered electric from the rubber is possessed of an atmosphere, of subtile particles, of *another* kind, attractive to the former.

If these two electrified bodies be gradually made to approach, when they come near to each other, a spark of light with a snapping noise will be perceived, and each body will have lost its electric atmosphere.

33. If they be again electrified as before, and a feather, or small pith ball, insulated, be made to approach either of them, it will begin to be attracted at a considerable distance; suppose that distance six inches; it is then evident that the electric atmosphere surrounding each body, extends six inches; consequently, as the electricities of the two bodies are of opposite kinds, they will begin to attract each other at the distance of twelve inches, if made to approach each other so near. Bring them to the distance of one inch, they will then *more strongly* attract each other; but, their atmospheres will *not unite*, so as to destroy each other, and pass away with a noise and flash of light, but, if they be drawn asunder, each will be found to be in the *same* electric

state, as before they were made to approach each other.

It appears then that the *two atmospheres* may be *perfectly commixed* with each other, and then be withdrawn *unaltered*—But, if the bodies be drawn still *nearer* to each other, for instance within about half an inch, every appearance of electricity suddenly vanishes, with a snap, and a flash of light.

34. On a former occasion (20) it was observed, a light small body, might be *wholly* immersed in an electric atmosphere, and yet not acquire an electric atmosphere itself, from that atmosphere by which it is surrounded; but, when it was carried *near* to the *surface* of the electrified body, at a *certain distance* it, instantly, became capable of attracting around it, a part of that very atmosphere, which, till then, it had *no* power of fixing around itself, or to its own surface (21); from whence it was inferred (24) and (25) that when it came to *that point* of distance, where it was enabled to attract an atmosphere to itself, it met
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with an atmosphere of a *different* kind from the external one: that the *external* atmosphere was connected with the electrified body itself, by means of *that internal* atmosphere of a different kind: that so soon as the little ball came in contact with that *internal* atmosphere, it attracted part of it around its surface, and then became capable of attracting around it, a *part* of the *external* atmosphere also, which, before it had acquired this internal atmosphere of a different kind, it could not: that it then became *completely electrified* itself, and was pushed aside, by the larger atmosphere of the greater body; and, consequently, that the phenomena of electricity depend upon an atmosphere of *one kind*, being excited upon the *surface* of a body, and *that*, again, being surrounded by an atmosphere of *another kind*, extending to a much greater distance from the body.

35. That every electrified body hath an internal atmosphere, of a particular kind, of a small extent, from its surface, and a more extensive

atmosphere of a different kind, around *that*, appears evident in the experiment under consideration also, as well as in that just cited: for, as was observed (33) two bodies, one electrified from the glass, and another from the rubber, may be brought so near together, that their *external* atmospheres shall perfectly penetrate each other, and, yet, may be again separated, in the *same* electric state as before; but, if they be suffered to approach till their *internal* atmospheres come into contact, an universal attraction and combination of *all* the atmospheres, of *both* bodies instantly takes place, and *every* electric appearance is *lost*, with the *destruction* of the atmospheric arrangement upon which it depended; while the fluids, formerly composing those atmospheres, *combine* with violence, and assume a *different state*, producing light, with a peculiar sound, or snap, by their new combination.

36. It is evident, then, that no body can acquire an external electric atmosphere, till it is possessed of the internal atmosphere of a different

ferent kind (24): that no body can deprive it of part of its external atmosphere, when once acquired, but by taking away part of its internal atmosphere; and, that the external atmosphere, of one kind, surrounding one body, cannot be destroyed by the external atmosphere of the other kind, surrounding another body, unless the two internal atmospheres of contrary kinds, also, come in contact; when, they will combine and destroy each other's peculiar arrangement; and the external atmospheres will then disappear, also, and, with them, every appearance of electricity (35).

37. From what hath been said then it is evident, that there are *two* active fluids, which, by *excitement*, in *certain* circumstances, are capable of becoming *electric*: because two atmospheres, acquired from the excited glass of an electrical machine, will not come near to each other; neither will two atmospheres, acquired from the rubber; but, an atmosphere, communicated to one body by the glass, will strongly attract an
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atmosphere communicated to another body by the rubber; consequently, they are *different* fluids, strongly attractive to each other: of one or other, therefore, of these two fluids, the external atmosphere of every electrified body is composed; but, the internal atmosphere of any electrified body, is *different* from its external atmosphere (24)—of what then are the *internal* atmospheres immediately surrounding the surfaces of electrified bodies formed?

38. I before mentioned my intention of calling *one* of these active fluids *Æther*, and the *other* *Phlogiston* (15), and shall, therefore, now, for the sake of distinction, have recourse to those names. Let then an insulated conductor be electrified, or surrounded by the two atmospheres in an electric state; and suppose the *external* atmosphere to be *Æther*: if another body, in its natural state, be brought near to it, but not so near as to discharge it, this *second* body will become electrified, but with the *contrary* kind of electricity; consequently, its *external* atmosphere will be *Phlogiston*.—Let
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another conductor be electrified with the electricity *contrary* to the former, that is, with an *external* atmosphere of *Phlogiston*; then bring the other body, again in its natural state, within this phlogistic atmosphere, but not near enough to discharge the electricity of the conductor, and it will be electrified, in a state *contrary* to that of this 2nd, conductor, therefore, its *external* atmosphere must be *ætherial*: the *approaching* body then, in the *former* experiment, was surrounded by an *external* electric atmosphere of *Phlogiston*; and in the *latter*, by one of *Æther*: but, it neither contributed any thing to the conductor, nor received any thing from it, in either case; therefore, the electricity it acquired, was merely, the *active principles*, naturally surrounding it, being *excited* by the electric atmosphere of the conductor, in each case, to assume an *electric state*; and, consequently, as in the *former* case, it became surrounded by an atmosphere of *Phlogiston*, and in the *latter* by one of *Æther*, it is evident, that it, *naturally*, was attended *both* by *Phlogiston* and *Æther*.

39. But, in the former case, when its external atmosphere was Phlogiston, what became of the *Æther*, naturally accompanying that Phlogiston? there was no appearance of it in the external atmosphere:—but it must be somewhere, and, as it hath been proved, that the Phlogiston of any body cannot become electric, unless the *Æther*, naturally combined with it, can become electric *also* (14) and that every body, in an electrified state, hath an *internal* atmosphere of *one* kind, and an *external* one of a *different* kind (24) it follows, that in the *former* experiment (38) when the *Æther* of the electrified conductor, excited the Phlogiston, naturally surrounding the approaching body to form an external atmosphere around it, the *Æther*, separated from *that* Phlogiston, by the electric excitement, immediately assumed an *electric* state upon the *surface* of the *approaching* body, and formed the electric *internal* atmosphere; and, that in the 2^d exp. when the electric phlogistic atmosphere of the conductor, attracted the *Æther* naturally surrounding the approaching body, and rendered it electric, the *Phlogiston*,
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separated from it, formed an *internal* electric atmosphere upon its surface.

40. It appears evident, therefore, that when a body is in an electric state, it hath an internal atmosphere of one of the active fluids, and, surrounding that, a more extensive atmosphere of the other; so that if the electrified conductor hath an *external* atmosphere of *Æther*, it hath also upon its surface, an *internal* atmosphere of *Phlogiston*: that if a body, with its *Æther* and *Phlogiston* in their natural state of combination, be brought within the external ætherial atmosphere of that conductor, that external ætherial atmosphere will attract the *Phlogiston* of the *approaching* body, and excite it to become electric, and form an *external* phlogistic atmosphere around it; and, at the same time, the *Æther* separated from it in consequence of that excitement, will become an *internal* electric atmosphere upon the surface of the approaching body: and that this is in reality the case, is further proved by observing that the body, thus electrified, will mutually attract and

be attracted by the electric atmosphere of the conductor, without destroying each other's electric properties, till they approach so near each other, that the *internal* atmosphere of the *one* can reach the *internal* atmosphere of the *other*; when, they will rush together, and the two internal and external atmospheres, by a complete union, will entirely disappear, and with them every appearance of electricity.

41. When, therefore, a man, standing upon the ground, presents his knuckle to an electrified conductor, the external atmosphere of the conductor attracts the contrary principle, of the two naturally accompanying the body, and gives it an electric form; while the other principle, separated from it by that excitement, becomes atmospheric immediately upon the surface of the knuckle, and, as it approaches the conductor, these atmospheres keep increasing by the increased power of the conductor, thus nearer to it, till at length the *internal* atmosphere surrounding the knuckle, comes in contact with the *internal* atmosphere

sphere of the conductor, when, being of different principles in similar states of excitement, and powerfully attractive to each other, they rush together, and with them the two *external* atmospheres also, now no longer capable of retaining their electric states, as being deprived of their respective internal atmospheres, upon which their peculiar existence and properties immediately depended; consequently, the two principles, in their different states of excitement, will rush into union, and by entering into a different state of combination, the conductor will be no longer electrified, but both it and the knuckle will be left in their natural state.

42. In like manner if an insulated body in its natural state, be brought near to an electrified conductor, if the external atmosphere of the conductor be *Æther*, that *Æther* will attract and excite the natural *Phlogiston* of the approaching body, to form an external electric atmosphere around it, while its natural *Æther* will, by separating from it, become excited upon the *surface*

of the approaching body, and form its *internal* electric atmosphere. If they be made to approach till the two internal atmospheres come into contact, they will unite with a snap, and give light; and then, if the body be suffered to approach near the conductor, its electricity being kept up, it will acquire an electric state, by communication, *similar* in *both* its internal and external atmospheres to that of the conductor; but, if the body, when only immersed in the external atmosphere of the conductor, so as to be in an opposite state of electricity, be withdrawn beyond the reach of the external atmosphere of the conductor, its natural principles, being only rendered electric by the attraction and excitement of the conductor, will soon *return* to their *natural state*, as their excitement was merely the consequence of attraction from the atmosphere of the conductor, which attraction being taken away, they must naturally return to their usual state: but, if a quantity of electricity be communicated, *besides* their natural proportion of the two principles, the surface of the body, to which it is communicated,

communicated, will have no natural power to alter the state of the principles acquired, and they will therefore retain their atmospheric state, and their electric properties.

43. It appears then that an electrified body, by attracting the Æther or Phlogiston naturally surrounding any other body, puts them into an electrical state: that if that body be withdrawn from the atmosphere of the electrified body, its Æther and Phlogiston return, by the natural attraction of the body to their usual state; and, that no body can be rendered independently electric, unless there be *communicated* to it a quantity of electric fluid, *not natural* to itself, but redundant.

44. But if a redundant quantity of the electric fluid be given to a body, it cannot retain it, unless *that* body be insulated by means of a non-conductor, or, unless it is fixed to *one* surface of a non-conductor, by the attraction of an electric fluid, of the contrary kind, on the *opposite* surface
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of that non-conductor, as is the case with the coated jar, which next presents itself to our consideration.

45. If a glass jar be coated within, but *not* without, and then placed upon a glass stand, and the inside be connected with the conductor, and electrified, the electric fluid will expand itself upon the coated surface, in the same *loose* manner as upon the conductor itself, without being capable of *fixing* to it, so as to charge it; the electricity being just in the same moveable state, as it is when a conductor alone is used.

46. If the jar be coated *both* within and without, in the usual manner, and be then placed upon glass, and connected with the conductor and electrified, it will be capable of *fixing* a *certain quantity* of the electric fluid, so as to form a *small charge* on the inner coating of the jar; and, the coating on the outside will be found to contain a quantity of the electric fluid of the contrary kind, just sufficient to saturate the electric fluid

fluid on the inner coating, if a communication be made between them.

47. If the *outside* coating of the jar be connected with other conductors, or non-electrics in their natural state, and then be electrified, it will be found capable of acquiring a *still greater* charge, or of accumulating and fixing a still greater quantity of the electric fluid on its *inner* surface; and its *external* coating will be found to contain affixed to, or accumulated upon it, an equally increased quantity of electric fluid of the contrary kind, sufficient to counteract and destroy the electric charge within.

48. It is evident therefore from (45) that the electric fluid *cannot* become fixed, or accumulated on the *inner* surface of the jar, unless there be some non-electric substance with its natural principles, capable of becoming electric, on the *outside* of the jar: from (46) that the *common principles* of the non-electric substance, or coating of the *outside*, are *excited* by the electric fluid on the inside
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to become electric, by being *attracted* by the *electric fluid* on the *inside*; by means of which attraction, the *two* electric fluids become *fixed*, each to its respective surface: from (47) that the quantity of electric fluid fixed within, depends upon the quantity of the common principles contained in, or supplied to the outer coating; and that whatever be the kind of electric fluid on the inner coating, *that*, on the outer coating, is contrary to it,—and capable of attracting and saturating it so as to completely destroy its electric properties, at the expence of its own.

49. Let us here stop for a moment, and, once more, supposing the doctrine of positive and negative electricity to be true, examine whether its explanation of these phenomena be more satisfactory than in the former cases, or not——

If a jar, coated as usual within and without, be placed upon a glass stand, its inner coating connected by proper conductors with the prime conductor, and then electrified positively, the

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inner coating will acquire a small charge of *positive* electricity, which, acting through the glass will *expel* all the *natural* electric fluid from the outside coating, which will therefore be electrified *negatively*.—The question then is, *where* is the natural quantity of the electric fluid driven to, which was expelled from the outer coating?—the glass stand could not conduct it away,—yet, the outside coating is, what they call *completely negative*.

50. Again, instead of placing the coated jar upon glass, let us place it upon a plate of metal, supported by glass, and electrify the *inside* of the jar *positively*: it will then be found to be capable of being charged *higher* than before, when the metal plate was *not* used.—Now, the positive electricity within, hath *wholly* driven away the natural electricity of the outside coating; where, then, is it driven to?—most probably into the metal plate, as there is nothing else to receive it—but, unfortunately, the metal plate is as *completely negative* as the outside coating of the jar itself, therefore, as the glass stand could not convey it away, it must

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either be *annihilated*, or the doctrine of positive and negative electricity must be *false*, as was proved before (8 &c. and 18 &c.) in every view which was taken of it, in the preceding considerations and experiments. But even were it true, it would prove a difficult matter to explain *why* the charging of a jar, or fixing the electric fluid to its inner coating, should depend upon the quantity of natural electricity, connected with the outer coating, to be driven away by it; or why the jar, standing upon a metal plate supported by glass, and unconnected with the rubber, should acquire a *higher* charge than when it stands upon the glass stand alone: or, in other words, why the *quantity* of electricity fixed on *one side*, should depend upon the *quantity* of natural electricity to be *driven away* from the other.—But enough of a theory so puerile and unnatural.

51. Let us then, as in the preceding cases, attend carefully to the circumstances of the experiment, and the appearances that present, without any regard to theory; and only admit of such

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conclusions as the appearances *actually require* to explain them.

52. Let then a prime conductor, insulated as usual, be connected with an excited glass globe or cylinder, from which it will acquire and become surrounded by an electric atmosphere, and will attract light bodies.

53. Take a pane of glass and place it between the conductor and any light body, within its electric atmosphere, and the light body will be attracted as before, which proves to a demonstration, that *glass* is *pervious* to the electric fluid, and does not prevent it from freely passing through it, and retaining its attractive power.

54. Fix a flat piece of metal, smaller than the pane of glass, to its center, on the *upper side*, and support it by the corners upon glass pillars; then electrify the metal by connecting it with the conductor, and it will have an electric atmosphere upon its surface, of the same slight, unfixed kind

as that surrounding the conductor, *without* the power of becoming *fixed* and *accumulated*, so as to form a charge.

55. Fix then another flat piece of metal to the *other* or *under* side of the pane of glass, place it as before, and then electrify it. The metal plate connected with the conductor, will then acquire a *small charge* by accumulating and fixing a small quantity of the electric fluid upon its surface; and at the same time, the metal plate on the *opposite* side will be found to have an electric atmosphere surrounding it, and detained upon its surface, but of the *contrary* kind of electricity to the former; consequently, the electric fluid communicated to the *first* plate of metal by the conductor, became *fixed* by means of its *attraction* to the *common principles* of electricity, which *naturally* accompanied the *second* plate of metal, on the *opposite* surface; because, when there was *no* substance containing these natural principles on the other side of the pane of glass, the electricity communicated to the

first plate of metal could *not* become fixed, so as to charge it.

56. Let a *third* plate of metal be connected with the second plate on the *under* side of the pane of glass, and let the whole be insulated as before; then, let the first plate of metal on the *upper* surface of the pane of glass be electrified from the conductor, and it will be found capable of acquiring and fixing a *greater* charge of the electric fluid upon its surface than in the former experiment (55), while the second and third metal plates, on the *opposite side* of the pane of glass, will be found to be *both* electric *alike*, and *together* to have affixed to them a quantity of electricity, capable of *destroying* the *charge* of the *first* plate; consequently, the electricity of the second and third plates was of the *contrary* kind, to *that* of the first plate, electrified from the conductor, and further proves that the *quantity* of electricity, fixed to the surface of the first plate, on one side of the pane of glass, is in *proportion* to the *quantity* of *natural principles*, connected with the *other side* of the glass

glass; and, likewise, that the electric fluid, communicated to the first metal plate, becomes fixed there, by its attraction to the common principles surrounding the substances on the other side of the glass; by which attraction those common principles are excited to become electric, and assume *that state, directly the reverse of the former.*

57. It is very evident, therefore, that the electric fluid on the surface of the metal, on one side of the pane of glass, is *fixed* there, so as to charge it, by its *attraction* to the *electric fluid* on the surface of the metal on the other side; and if a communication between the two metal plates, is made by means of a conductor, the *two* electric atmospheres rush together with violence, and the metal, on either side, is left in its *natural state*, or *without* any appearance of electricity.

58. And it is equally evident, that, as the quantity of electricity capable of being fixed to the first metal, is proportionate to the quantity
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of common electric principles in their natural state, connected with the second metal, so, when the second metal plate is connected with the earth, by which it can be supplied with any quantity of those common principles, the quantity of those common principles, thrown into an electric state, and detained, and fixed by the second metal, is always proportionate to the quantity of electric fluid communicated to the first metal, by the conductor: which further proves that their becoming fixed to each surface, so as to charge the pane of glass and its coatings, *entirely depends upon their attracting each other through the glass.*

59. If *two* panes of glass, equal to each other, be coated with metal, or *two* equal coated jars, which answer the same purpose, be electrified *within* from the conductor, the *outer* coating of *each* jar will acquire an *equal* charge of electric fluid. Now, the *inside* electric atmosphere of *one* jar, will *not* unite with *that* of the *other*; which proves that they have *no affinity* with each other, as
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being of the *same kind*: but, if the electric atmosphere of the *inside*, be conducted to the electric atmosphere on the *outside*, they will rapidly combine, and destroy each other; which shews that the atmosphere on the *inner* coating of the jar, is different from that on its *outside* coating, and hath a strong attraction to it: while *two inside*, or *two outside* electric atmospheres have no attraction for each other, though equally electric.

60. Whatever, therefore, be the fluid which forms the electric atmosphere upon the surface of the inside coating of the jar, the fluid, at the same time surrounding its outside coating, is of a different nature, though capable of a similar excitement; in which state they strongly attract each other. They are, with respect to each other, what an acid is to an alkali; and the very arguments which can prove that they are the *same fluid*, or that one is an *accumulation*, and the other a *privation* of a natural electric fluid, at all times existing, will, likewise, do to prove that an acid and an alkali are *one* and the *same thing*, or that an
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acid is only an *accumulation* of *neutral* properties, and an alkali is a *neutral* without any properties at all.

61. It must follow then that there are *two* fluids, which are capable of becoming *electric* atmospheres; and that when *one* is communicated to the *inside* coating of a jar, it attracts the *other* principle, through the glass, by which attraction *that other* principle becomes *electric* also, and *one* forms an *electric* atmosphere *within*, and the *other* without the jar; which, by their mutual attraction *fix each other* to their respective surfaces, so as to be capable of *accumulation*; in which state the jar is said to be *charged*.

62. Let us here, for the sake of distinction, make use of the names which I formerly proposed to distinguish them by (15), and call *one* fluid *Æther*, and the *other* *Phlogiston*. If *Æther*, then, be thrown *into* a jar, whose *inside* is connected with the prime conductor and glass globe, the *outside* coating will have an atmosphere of *Phlogiston*, that

is, the action of the *Æther* within will excite the *Phlogiston*, naturally contained in the metal coating on the *outside*, to become *electric*; and if a communication be made by any conducting substance, between the inside and outside coatings, the *Æther* from *within*, and the *Phlogiston* from *without* will rush together, and destroy each other's electric properties.

63. But, it is well known, that if the inside of a coated jar be connected with the insulated rubber of the machine, or with an excited globe of sulphur, it will acquire an *electric charge* of a *contrary kind* to that which is communicated from the glass globe, therefore, if the *inside* of the *former jar* (62) acquired an electric atmosphere of *Æther* from the globe and conductor, the electric atmosphere communicated to the inside of this *second jar* connected with the rubber must be *Phlogiston*, and the atmosphere on its *outside* coating being of the *contrary kind* to that within, must be *Æther*: 'tis evident then, that when *Æther* is communicated to the inside of the jar,

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the *contrary* principle or *Phlogiston* becomes electric on the *outside* coating (62), and when an electric atmosphere of *Phlogiston* is thrown upon the inner coating of the jar, that the *outer* coating immediately shews an *ætherial* atmosphere: consequently, 'tis evident, that whether the electric atmosphere, communicated to the inside coating of the jar, be *Phlogiston* or *Æther*, the *outside* metallic coating furnishes the *contrary principle*, which is attracted by the former and rendered *electric*; and, therefore, the *outside* coating, naturally, contains *both Phlogiston and Æther*; either of which is ready to become *electric*, whenever a *proper excitement* is given.

64. But, as the *outside* coating naturally contains *both* the principles in their *common inactive state* of combination, if the jar be insulated during the experiment, it is certain that when the electric fluid is given to the inside, *both* the principles still remain on the *outside* coating, though *one only* be *evident*. If the *inside* of the jar be electrified with *Æther* from the globe;

the *Phlogiston* is evidently electric on the *outside* coating; but if *Phlogiston* in an electric state be thrown *into* the jar, from the insulated rubber, then, an electric atmosphere of *Æther* will be perceived on the *outside* coating of the jar. But though the *Phlogiston* alone of the outer coating be *evident*, in the former case, the *Æther* which was naturally combined with it when in their common state, *must* be *somewhere*, and in *some separate state* of excitement; therefore, as the atmosphere extending around is *Phlogiston*, the *Æther*, belonging to that *Phlogiston*, must be *somehow excited* and *connected* with the *surface* of the *outside* coating; and when an atmosphere of *Phlogiston* is communicated to the inside coating from the rubber, and the *natural Æther* of the *outside* coating is excited by it, to surround the outer coating, the *Phlogiston* naturally accompanying that *Æther* must be *somewhere*, and will, therefore, *affix* itself to the *surface* of the *outer* coating.

65. We are therefore naturally led by our investigation of these experiments with the coated
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panes of glass, or coated jars, to form the *same conclusion*, with respect to the *nature and construction* of the *electric atmospheres*, as when the simpler experiments with excited glass and its conductor were considered (34), which is, that there are *two principles*, *Æther* and *Phlogiston*, naturally combined in a common or quiescent state, and accompanying and connected with *all bodies*: that whenever *one* of them is by any means excited to become *electric*, on the *surface* of a body, the *other* by separating from its natural combination with it, becomes *electric also*, and forms an *atmosphere* around the *other*: that if a body, with its common *Æther* and *Phlogiston* in their common state, be brought within the *external atmosphere* of the excited body, *that external atmosphere* attracts the *contrary principle* of the approximated body, into a *similar electric state* with itself, while the *other principle*, *disengaged* from that contrary principle, by its *excitement* becomes *electric also*, and forms an *internal atmosphere* immediately upon the *surface* of the approaching body; for instance, if *Æther* be excited and attracted by friction

friction upon the surface of glass, the *Phlogiston*, belonging to that *Æther*, will surround it like an *atmosphere*; and, if an insulated conductor be brought near to the excited glass, the internal atmosphere of *Æther* will diffuse itself upon the surface of the conductor, carrying along with it its external atmosphere of *Phlogiston*. If any conducting substance containing *Æther* and *Phlogiston* in their *common state*, be brought within that *phlogistic external atmosphere*, it will attract the *Æther* of that body, and excite it to form an *external atmosphere* around the *approaching body*, while the *Phlogiston*, disengaged from its natural connexion with that *Æther*, will become excited to form an *internal atmosphere*, immediately upon its *surface*; and if the body is suffered to approach the excited conductor, till the internal atmosphere of *Æther* on its surface, can come in contact with the internal atmosphere of *Phlogiston* on the surface of the *approaching body*, the whole of the atmospheres of *both* will rush together and *vanish*, with every appearance of electricity. But this mutual combination and destruction of each
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other's electric properties, *never* happens, till the *internal atmospheres* come into *contact*.

66. It appears evident then (64) that when a coated jar is charged, both the *Æther* and *Phlogiston*, naturally belonging to its outside coating, are excited to become electric atmospheres, *one* immediately upon the *surface* of the coating, and the *other* widely *surrounding* that: and from the preceding considerations, it is certain that every body, having an electric atmosphere of *one* kind upon its surface, hath another atmosphere of the *other* active principle *surrounding* that like an *external atmosphere*: consequently, the electric fluid, communicated to the *inside* of the coated jar by the *excited glass*, also, is composed of one of the natural active principles immediately upon the surface of the inside coating, while the other principle, separated by excitement from its natural combination with it, forms an external atmosphere around it: and this being admitted, every difficulty, at once

its manner to the external atmosphere of Phlogiston

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vanishes, and every electrical phenomenon is readily explained.

67. For if *Æther*, by means of the rubber, be excited to become electric upon the surface of the globe, the *Phlogiston*, which was naturally combined with that *Æther*, will be excited to form an external atmosphere around it; in that state it passes along the conductor to the inside coating of the jar; that inside coating will, therefore, have an atmosphere of *Æther* upon its *surface*, and surrounding that, an *external* atmosphere of *Phlogiston*. Now, as is well known (53) the electric fluid readily pervades glass, therefore, that *internal* atmosphere of *Æther* will attract the *natural Phlogiston* of the *outside* coating, and excite it to assume a *similar state*; it will therefore form an *internal* atmosphere on the *surface* of the *outside* coating, and its *attendant Æther* will *separate* from it, and form an *external atmosphere* around it. The *internal* atmosphere of *Æther*, will therefore become *fixed* to the *inside* coating, by means of its *attraction* to the *external* atmosphere of *Phlogiston*

giston on the *outside* coating; and the jar may be fully charged, if the supply of common principles to the outside, be proportionate to the quantity of electric fluid thrown into the jar, but not otherwise.

68. In this state, when each coating of the jar is surrounded by its atmospheres, and they are fixed by the *mutual attraction* of the *two internal* atmospheres of the *opposite* coatings, tis evident, that their *external* atmospheres being of the *opposite* kinds of fluids, if they are brought together by any conducting substance, they will *attract* each other; but if they are brought so as to mix ever so intimately with each other, they will *not discharge* the electricity of the jar, because, as before observed (35 and 36), two *external* atmospheres *cannot unite* together and separate from their internal atmospheres, unless *those internal* atmospheres can unite also. But if the internal atmosphere from the *inner* coating be conducted to the internal atmosphere of the *external* coating, they will rush violently together so soon as they

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come into contact, and, with a violent explosion, the whole of *both* atmospheres, and *all* their electric properties will disappear; which fully proves that there are *two* principles, capable of becoming *electric*, and that *every* electric atmosphere is composed of *one* or *other* of those principles, excited to form an atmosphere upon the *surface* of the electrified body, while the *other* principle, naturally accompanying the former, but now separated from it, becomes excited to form itself into an electric atmosphere *around* the *former*: and, that, as the electric fluid, so called, is of *two* kinds, so *one* of them is formed of *Æther*, excited upon the surface of a body, with its *Phlogiston* around it, and the *other* is produced when *Phlogiston* is rendered electric upon the surface of a body, while the *Æther*, naturally accompanying it, is excited to form itself into an atmosphere around it.

69. Glafs, therefore, and the substances called *electrics per se* have naturally a *peculiar attraction* to the two principles upon which elec-

electricity depends; by which they are always detained in a *certain* state of excitement upon their surfaces: in which state they *prevent* the electric fluid, when formed, from passing along their surfaces, by having a *slight attraction* to it. When therefore it is communicated to any part of the surface of a pane of glass, for instance, by the *natural excitement* of the principles attending the surface of the *glass*, it is slightly fixed to that spot, and cannot diffuse itself; but it readily acts *through* the glass, and if any substance, containing the common principles in their natural state, is in contact with the opposite side of the glass, *those common principles* are rendered *electric* in the usual manner. But those substances which are called *non-electrics*, or *conductors*, having *no* peculiar attraction to the common principles, Æther and Phlogiston, so as to give them any excitement, the electric fluid *readily* passes over their surfaces, so as to diffuse itself equally over the whole extent of the conducting surface.

70. Electrics per se, and particularly glass for instance, hath then a peculiar attraction to the two common principles, Æther and Phlogiston, and naturally gives them a peculiar but slight excitement, in consequence of which if those principles be still more excited by friction with certain substances containing the common principles, they immediately attract and excite *one* of those common principles of the rubber to assume an atmospheric state, upon the surface of the excited glass; and the *other*, by that means no longer united with it in their usual and common state of combination, forms itself into an atmosphere surrounding the former.

In this state, which is called electric, the two fluids, by means of their peculiar attraction to the glass, or the fluids naturally in a slight degree excited by it, are *detained*, and *incapable* of diffusing themselves upon its surface. But if an insulated conductor be connected with the excited glass, these electric atmospheres readily diffuse themselves upon its surface, still keeping their
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former atmospheric states, one around the other as before observed (65).

71. Glass, therefore, by friction excites the common principles, supplied by the rubber, to become electric; consequently, to keep up the electrization, 'tis necessary that the rubber be connected with bodies containing those principles in their natural, or common state; and those bodies are called conductors; and, it is likewise evident, as the electric atmospheres, when once formed, throw the common principles of other bodies within their extent into an electric state, *opposite* to that of the glass itself, that the *common principles* of the *rubber* will be thrown into *that electric state contrary* to that of the glass; and that if the glass moves upon the rubber, or that upon the glass, the electric atmosphere of the *glass* will give the *same motion* to the electric atmosphere of the *rubber*; and when the glass *separates* from the rubber, the electric atmosphere of the rubber will be *drawn* over its parting edge and *recede* to its *posterior parts*.

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This electric fluid of the rubber, by means of proper insulated conductors may be collected, so as to charge a coated jar, which, in that case, will be of the contrary kind to that communicated to a jar by means of conductors connected with glass, but, if it be *not* taken away by proper insulated conductors from the rubber, it flows back; the two fluids return to their usual state of combination, and equally diffuse themselves around. So it is likewise with the glass and its conductors, let the friction be ever so great, or ever so long continued, the fluids, thrown into an electric state around them, readily unite with each other, producing rapid and innumerable corruscations with a hissing or cracking noise, and no permanent accumulation of electricity can be procured; because in that manner they combine and return to their common state.

72. Glass then hath, naturally, a *peculiar* slight *attraction* to the *two* active principles, *Æther* and *Phlogiston*, very different from what other bodies, called conductors or non-electrics have; in consequence

sequence of which the electric fluid is *prevented* from *diffusing* itself upon its surface; but when an electric atmosphere is communicated to *one* surface of a pane or jar of glass, it readily acts *through* it, and by that means, if any substance containing those principles in their natural state is in contact with the opposite side of the glass, they are excited to become electric in a contrary manner or state, with respect to the fluids forming the internal and external atmospheres; but, as the electric atmosphere on the former or inside of the glass jar, cannot pass entirely through it, is it not probable that the *two fluids naturally* attracted by the glass become *peculiarly excited* by the presence of the electric fluid, or by means of friction so as to *separate* from their common state of combination with each other, *one* being *excited* and *attracted* to *one surface*, and the *other*, by that means receding from it, becoming *equally excited* on the *opposite surface* of the glass? So it is with iron—it hath a peculiar attraction to both Æther and Phlogiston, which naturally surround it in their common state of combination, but, if
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by any means the *Æther*, or *Phlogiston* be drawn, or excited at *one end* of the needle, the contrary principle immediately recedes to the opposite end of the needle; in consequence of which it becomes magnetic, having *all* its *Æther* at *one* end, and *all* its *Phlogiston* at the *other*: each forming an atmosphere around its respective pole: each being attractive to iron, on account of the contrary principle naturally surrounding it: the *north* pole of *one* magnet strongly attracting the *south* pole of *another*, because one is *Æther* and the other *Phlogiston*, which, in similar states of excitement, strongly attract each other, and neither of them having any attraction to the *similar* pole of another magnet, because it hath an atmosphere of the *same* kind of fluid with its own; consequently, there can be no attraction, but they must *resist* each other if any attempt is made to bring them together, which resistance is commonly called repulsion.

73. It appears therefore natural to conclude that glass hath a peculiar attraction to *Æther*
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and Phlogiston, in their natural state of combination: that when it is excited *all* its *Æther* becomes active upon *one* of its surfaces, and *all* its *Phlogiston* on the *other*: that the *phlogistic* side of the glass will attract an immediate atmosphere of *Æther* from surrounding bodies, and that the *Phlogiston*, separated from that *Æther* will assume an active state around it, so as to form an *external* atmosphere; and that the *opposite* or *ætherial* side of the excited glass will throw the common principles connected with it, into a similar atmospheric state, but where the *Phlogiston* is excited to the *surface*, and the *Æther* forms the *external* atmosphere; and that the state of *one side* of the glass, depends so much upon the *other side* being in a *similar state*, that the first side *cannot attract* and *fix* to itself any considerable quantity of electric fluid, unless the equilibrium or counter-action is kept up on the *contrary side*, by a supply of the *common principles* from the neighbouring conducting bodies; which, being thrown into an electric state, form an atmosphere on the contrary side of the glass, which prevents the

excited natural principle on that side of the glass, *from uniting* with its counter-part on the other side, so as to return to their natural state; consequently, while each natural active principle of the glass hath an equal atmosphere around it on its respective side, the glass is charged; but *neither* side can be charged, unless the *other* is supplied with the principles in their common state, to enable it to acquire an *equal atmosphere* to counter-act the former.

74. The whole theory of electricity may then be comprised in the few sentences which form the following

RECAPITULATION.

A. There are two active principles, Æther and Phlogiston, strongly attracting each other, and at all times and in every place present; they are naturally combined with each other, in which common state, they are not perceptible by us. But if by any means they be separated, the
activity

activity of each becomes instantly manifest, and the separating power that excites the one gives a similar excitement to the other also.

B. Every substance, therefore, is surrounded by these two active principles in their common state of existence: but some bodies, such are those called electrics per se, or non-conductors seem to have a peculiar attraction to them, so as to give them a kind of natural excitement sui generis, which natural excitement may be greatly increased by friction, so much so as to enable the electric body to attract these active principles from surrounding bodies.

C. But when an electric substance, particularly glass for instance, as being the most commonly used, is excited by friction, its natural principles become sensibly active, which they were not before excitement, because they then were in their common state of combination; therefore, as they are *now* rendered active, they must be in a *state of separation (A)*: therefore, when glass is

excited, its *natural Æther* becomes *active* upon one of its *surfaces*, and the *Phlogiston* naturally combined with that *Æther* before excitation, becomes *active* on its *contrary surface*.

D. Glass, therefore, in its common state, is equally accompanied by *Æther* and *Phlogiston*, which, combined together, pervade its pores readily; but, by excitement, the *Æther* is *all* drawn to *one surface*, and the *Phlogiston* *actuates* the *other*.

E. But in this excited state of the glass when its principles are in a state of separation, and consequent activity, as before observed (B), these actuated principles are capable of attracting the common principles from *other bodies* near them; by common principles I mean *Æther* and *Phlogiston* in their common state of combination; 'tis natural therefore to suppose that each of these principles of the excited glass, in its separate active state, will most powerfully attract *that principle* of the two, which it hath an affinity with,
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from surrounding bodies; consequently, that surface of the glass which contains its excited *Æther*, will most powerfully attract the principle of Phlogiston from them, which will become excited to form itself into an *atmosphere*, upon the *ætherial surface* of the glass; and the *Æther*, separated from its natural combination with that Phlogiston, by its excitement will form itself into an *atmosphere* externally surrounding that internal, acquired atmosphere of Phlogiston; the *ætherial surface* of the glass will, therefore, become electric, by having upon its surface an *internal* atmosphere of Phlogiston, surrounded by an *external* atmosphere of *Æther*; upon which atmospheres the electric properties depend: and the *opposite*, *phlogistic* surface of the glass, for the same reasons, would become electric by attracting from neighbouring substances if near it an *internal* atmosphere of *Æther*, with its *Phlogiston* surrounding it like an *external atmosphere*.

F. When a glass globe is thus excited by means of its rubber, so as to have an electric
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atmosphere, formed of one of the active fluids surrounding the other, if a non-electric or conducting body, insulated, be brought near to it, the electric atmospheres will diffuse themselves upon its surface so as to render the conductor electrified.

If any other conducting substance, insulated, be brought within the extent of the external atmosphere of this electrified conductor, that external atmosphere will attract the contrary principle naturally accompanying the approaching body, by which attraction it will become excited to form itself into a similar atmosphere around the approaching substance; and, the other principle which was naturally combined with it, by its separation will become active and excited also, so as to form an internal atmosphere immediately surrounding its surface; consequently, by its approach to the excited conductor, it hath its natural principles thrown into an electric state, but in a *contrary direction* to that of the excited glass or its conductor; for, if the internal atmosphere of the glass be Phlogiston, its external atmosphere must be Æther, and that Æther will
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attract the natural *Phlogiston* of the *approaching substance*, to form itself into an *external* atmosphere, while the disengaged *Æther* will form its *internal* atmosphere.

G. If, in this state, the body be made to approach the conductor, till its *internal* atmosphere can reach the *internal* atmosphere of the conductor, they will rapidly *unite*, with a snap and a spark, and *destroy* each other's electric appearances, or properties; but, if the approaching body be brought in contact with the conductor, and does not contain enough of the common principles to saturate its excited atmosphere, or the excitement between the glass and the rubber still goes on, so as to produce fresh supplies of electric matter, that electric matter will then *diffuse* itself upon the *surface* of the approaching body, which will, consequently, acquire an electric atmosphere *similar* to that of the conductor itself.

H. In

H. In this electrified state if a small pith ball, suspended by silk, be brought within the external atmosphere of the conductor, the natural principles of the pith ball will be thrown into an electric state also, and by means of the attraction of the external atmosphere of the conductor to the contrary principle of the ball, it will be drawn towards the conductor, till it reaches the internal atmosphere; its natural principles will then combine with the electric principles of the conductor, and afterwards the ball will become *surrounded* with *part* of the *internal atmosphere* of the conductor, by which it will be enabled to attract a *proportionate share* of the *external atmosphere* also; and becoming electrified, in a *similar* manner with the conductor itself, will be *pushed away*, on account of its levity, by the larger atmosphere of the conductor, so as to float upon its surface.

I. It appears then (from *G* and *H*), that when two bodies have similar electric atmospheres, that is when the internal or external atmosphere of each, is formed of the *same* kind of principle, they

they will *not* approach each other, nearer, than where those external atmospheres come in *contact*, unless they be pressed together, by a force greater than their natural tendency to arrangement; and when that force is taken away, they will instantly *recede* to the full extent of their respective atmospheres; which separation, or recession is called repulsion.

K. It was observed (*F*) that the electric atmosphere of excited glass, when communicated to an insulated conductor, attracts the common principles of an approaching body, and throws them into a *contrary* state of electricity; so it is with the *rubber* by which the glass is excited: its common principles, by friction are excited and attracted to the surface of the glass, and rendered electric; in which state they exert their influence upon the *back parts* of the rubber, and attracting the common principles *there*, put them into an electric state contrary to that of the electric atmosphere of the glass itself, and draw them to it; by which means, the rubber itself acquires a power of attracting the common principles from other

substances connected with it; which are by that attraction made to flow towards it to restore the loss, and supply the glass; consequently, whatever be the state of the electric atmosphere of the glass, that of the rubber is contrary to it.

When the glass, therefore, is excited by the rubber, it attracts an electric atmosphere of the two active fluids, in a certain state; by which electric atmosphere the active fluids of the rubber are excited to assume an electric form, in a *contrary* state or direction; if the glass, with its electric atmosphere, be made to *move* upon the rubber, the electric atmosphere of the rubber is attracted so as to acquire a *similar motion*; and, when the excited part of the glass leaves the rubber, the atmosphere upon the surface of the glass is carried along with it, and the atmosphere of the rubber is drawn over its edge, and recedes to its back parts. If an insulated conductor is applied to the glass with its electric atmosphere, when it separates from the rubber that electric atmosphere will diffuse itself upon the surface of
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the conductor, which will then become electrified; and, if the rubber be insulated, and an insulated conductor be ready to receive its electric atmosphere, when it separates from the glass and flows over the edge of the rubber, this conductor, also, will acquire an electric atmosphere, of a *contrary kind* to that communicated to the former conductor by the excited glass, which will strongly attract and rapidly combine with it. But if no insulated conductor be ready to receive the electric atmospheres, either from the glass or rubber, in both cases, the two principles, forming the electric atmosphere of each, will combine with each other, and return to their common state of combination.

L. If the inside of a coated jar be properly connected, by means of conducting substances, to the electrified conductor, the electric atmosphere flows along those conducting substances to the inside coating of the jar, and *excites* the *common principles* of the *glass* of the jar itself; in consequence of which excitement, those common

principles instantly *separate*, and *one* of them collects itself upon the *inner* surface of the glass of the jar, while the *other* becomes active on the *opposite* or *outer* surface. Suppose the *internal* atmosphere of the communicated electric fluid to be *Æther*, that *Æther* will excite the *natural Phlogiston* of the *glass* to become active upon the *inner* surface of the jar, and the *natural Æther* of the glass of the jar will collect itself, and become active on the *outer* surface of the jar; by thus becoming active it will immediately excite the common principles of the outside coating of the jar to become electric also, the *Phlogiston* of that coating will be immediately attracted by the *ætherial* surface of the glass to form an *internal* atmosphere, and the *Æther* separated from that *Phlogiston*, will form an *external* atmosphere, around it; so that the *outer* coating of the jar will have an electric atmosphere, in a *contrary* state to that upon the *inner* coating.

M. Glass then is excited when by friction, or any other means, the *common quiescent state* of
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its *Æther* and *Phlogiston* is broken, and the *Æther* becomes *active* at one of its *surfaces*, and the *Phlogiston* at the *other*: in this excited state, either principle is capable of attracting the *contrary* principle from surrounding, or contiguous conductors, which forms itself into an *atmosphere* upon *that surface* of the glass, while the *other* common principle, separated from its usual combination with it, immediately becomes *active* and forms itself into an *atmosphere* around it; and, whenever this electric atmosphere is communicated, and applied by means of a proper coating to one *surface* of glass, the *natural principles* of that glass become excited, and *that principle* which possesses itself of the *contrary* surface of that glass, attracts, to itself, an electric atmosphere from the *common principles* of the *outer* or *contrary* coating; by which means, the two contrary principles, proper to the glass, are prevented from uniting: and as fast as *electric fluid* is communicated to the *one side*, the *other* becomes excited to attract *more* and *more* of the *common principles* on the *other side*, to counteract it; by which means, an *equilibrium*

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is kept up, and the glass is *charged* by each side having an *equal quantity* of *electric atmosphere* around it; and the two contrary atmospheres are *fixed*, by each being *strongly attracted* by its *respective excited principle* of the glass, which principle, on each surface of the glass, is strongly attracted by the *other*: consequently, the atmospheres can only be discharged by *external communication*; which being made, so soon as the *internal* atmospheres come into contact, being *contrary principles in similar states*, they rapidly *combine*, and *disappear*, with their *external* atmospheres for the same reason also; and their *electric properties* are *no more*.

This, therefore, is the general theory, and these the principles, from whence, all the phenomena of electrical attraction, repulsion, &c. must be explained.—Every body, in an electric state, must have an internal atmosphere of *Æther* and an external one of *Phlogiston*, otherwise, its internal atmosphere must be *Phlogiston* and its external of *Æther*: two bodies with external atmospheres

mospheres either of Æther or Phlogiston, will not attract, but *resist* each other; but, if one have an external atmosphere of Æther, and the other of Phlogiston, they will strongly *attract* each other: and, if they approach till the *internal* atmosphere of *each*, comes in contact with the other, the four atmospheres *rush* into *union*, and *disappear* with a snap and a spark.

In short, these principles and this theory, alone, can rationally explain the phenomena of electricity, which never will be understood unless they be admitted.

I wish not to be misunderstood, when speaking of Æther and Phlogiston; I mean by Phlogiston, a something, possessing very different properties from those given to it by Stahl, and others since his time; and by Æther, I intend something should be understood very different from the Æther of Sir Isaac Newton; but, rather than coin new names, I have adopted those, as being something like them in some respects. But, that my ideas
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may be fully known respecting them, although I have formerly explained them in my Tract on the Generation of Animal Heat, and again, more fully, in my Elementary Principles of Nature, yet, as those tracts are little known, I shall beg leave again to define them: Æther and Phlogiston are two principles, composed of impenetrable or solid particles of matter, and *actuated* by the *power of attracting* each other when in contact; and not only each other, but also the *fixed particles* of matter, *not actuated* by the *same properties* as they are.

When particles either of Æther or Phlogiston are by any means excited, they attract each other in a *rectilinear* manner, so as to form themselves into an *atmosphere* around the exciting body; as for instance, when these two principles are excited around a needle of steel or iron, the particles of Æther attract *each other* so as to form themselves into an *atmosphere* around *one pole* of that needle; and the particles of *Phlogiston* form themselves into *diverging lines* around the *other pole*

pole, so as to become an *atmosphere* around it also.

In their *common state* they are *combined together*, and *not* sensibly active; as is the case with *common iron*; but, when they are by any means *divided*, they become *evidently active*, as is the case when *iron* is rendered magnetic.

In this *active*, or *divided state*, two atmospheres of the *same kind* of active particles, have *no attraction*, but *resist* each other; as is evident when *similar poles* of two magnetic needles are presented to each other; but, if an atmosphere of *Æther* be brought in contact with another of *Pblogiston*, they strongly *attract* each other, till their respective fixed centres are brought into *contact*; as is sufficiently evident when the *north pole* of one magnetic needle, is brought within the atmosphere surrounding the *south pole* of another.

These active principles are capable of receiving *different degrees* of *excitement*, and the *properties* they

they acquire are as *different* as the degrees of excitement themselves; and in *very different* states of that excitement, they have *no sensible action* upon each other. For instance, either *Æther* or *Phlogiston* by means of *iron* may be excited to become *magnetic*: by *glass* they receive a different degree of excitement, and assume those appearances and properties which we call *electric*; and by a different kind, or degree of excitement, from the *fixed particles* of matter, they acquire those peculiar properties which we call *acid* or *alkaline*.

So, likewise, as they are capable, separately, of existing in different states of excitement, having different sensible properties, they are also capable of *combining* in *different states* of activity, and producing, *together*, *active fluids* *very different* from each other: in their *common* state, as before observed, they are *not evident* to us: when in the state of *electric atmospheres*, by uniting they form *light*; and when the *Phlogiston* of an *inflammable body* combines with
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the *Æther* in *pure air*, they form *fire*, and very frequently, at the same time, *light*.

In short, *Æther* and *Phlogiston* are the two active principles which produce the phenomena of magnetism, electricity, gravitation, chemical affinities, light, fire, and all those active variations of nature, which we contemplate with wonder, and gaze at with admiration! for *proofs* of what I now assert, I refer those who have inclination to know them, and candour enough to give them their due weight, to the full explanation I have given of them, in the *Elementary Principles* before-mentioned.

FINIS.

ERRATA.

- Page 9. line 5. before Every put *it*.
.... 26. 3. (from the bottom) read *atmo-
sphere.*
.... 33. 7. (ditto) read *approach.*
.... 61. 5. read (24)—and line 13 for *other*
read *former.*
.... 64. bottom line—read *internal.*

